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Frequency of radial artery occlusion in patients with diabetes mellitus 24.hr and one month after coronary intervention

Dr Sajjad Ali
Fellow Interventional Cardiology, Hayatabad Medical Complex Peshawar

Dr Muhammad Abbas Khan
Fellow Interventional Cardiology, Hayatabad Medical Complex Peshawar
Corresponding author email: Drabbas.cardio@gmail.com

Dr Kanhiya Lal Talreja
Medical unit, Dr Ruth K.M pafu Civil Hospital Karachi

Muhammad Hasnain Aslam
Medical officer THQ Dunya Pur

Neelam Akbar
Women Medical Officer THQ Melsi

Dr. Muhammad Ahmad
Former House Officer Combined Military Hospital (CMH) Multan

Sudhair Abbas Bangash
Faculty of Life Science, Department of Pharmacy, Sarhad University of Science and Information Technology, Peshawar, Pakistan

Ariba
Department of Life Sciences, School of Science, University of Management and Technology, Lahore, Pakistan

Maryam Batool
Department of Life Sciences, School of Science, University of Management and Technology, Lahore, Pakistan

***Abstract*---**Introduction: Transradial coronary intervention (CI) is frequently complicated by radial artery occlusion (RAO). The research has a variety of prevalence reports, and its indicators are not properly known. The purpose of this research was to analyze the frequency of RAO in diabetes mellitus patients 24 hours and one-month following

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CI. Methods: In this study, 1,350 participants (included 101 repeated operations after one month) who undergo 1,451 CI, were involved. Participants were assessed for RAO 24 hours and one month following CI. The major result was not identified in 47 participants (3.2%), thus, data on 1,303 participants were provided for analysis of the data. After receiving CI for 24 hours and a month, individuals with diabetic mellitus (DM) had their predictors of RAO examined using multiple regression analysis. Results: The total participants of 1,303 included 1,018 (78.1%) men and 285 (21.6%) women, with an average age of 57.6 years. The major result was not identified in 47 participants (3.2%), thus, data on 1,256 participants were provided for analysis of the data, in which 149 participants (12.3%) had the primary outcomes. There were 46 women (30.2%) in the RAO group. In the RAO cohort, DM was found in 58 (39.5%) individuals. Thirty-four (2.0%) of the RAO patients had a family background of MI, and 34 (2.9%) of the RAO patients were cardiovascular unstable. Twenty (13.9%) individuals also had a previous MI in their medical history. Individuals who had myocardial instabilities during surgery and females 2.6% (p=0.002) and 30.2% (p=0.003) were more likely to develop RAO. Conclusion: RAO was a prevalent CI consequence, notably in the Pakistani population, and was frequently an asymptomatic issue. In order to adapt to abrupt changes in radial arterial flow during RAO during general anesthesia, DM patients lack the vasoreactivity of the ulnar artery. For high-risk individuals, a thoughtful treatment strategy and follow-up must be developed in order to guarantee radial artery patency. Understanding factors may be useful in preventing it.

***Keywords*---**RAO, trans radial access (TRA), diabetes mellitus, CI.

Introduction

The recommended vascular route for cardiac treatments is currently transradial CI technique, which is being utilized more often (Haq et al., 2016). TRA benefits include low patient pain, convenience of performing therapeutic and diagnostic cardiac procedures, early patient mobility, duration of hospitalization, and decreased hospital expenditures (Mattea et al., 2017). Coronary artery bypass graft occlusion reduces survival, causes angina to return, and necessitates more revascularizations (Bartnes *et al.*, 2010).

Among the TRA consequences which impacts a significant fraction of participants more frequently is RAO (Avdikos et ak., 2017). The basic route for CI is the transradial channel. Reduced infiltrative radial artery exposure led to a considerable improvement in patient convenience and a decrease in punctured site problems when matched to the femoral artery method (Roffi et al., 2016; Wang et al., 2022). Because of radial artery spasms and occlusion during transradial CI, which can be triggered by the cumulative effects of catheter-induced endothelial damage and a reduction in blood circulation following membrane and catheters placement (Dwivedi *et al.*, 2022).

The time of examination as well as the method employed for the identification of RAO have an impact on the frequency of RAO, which changes in various research and ranges between 1% and 42%. RAO is now a common side effect of radial artery (RA) access, and it was documented that RAO prevalence following CI was between two and ten percent (van der Heijden et al., 2018). The RA and ulnar artery provide the hand's primary flow of blood. RAO is typically asymptomatic in clinical because the ulnar artery may deliver a single blood flow for the hand after RA obstruction (Wang *et al.*, 2018).

Since TRA has emerged as the favoured approach for percutaneous coronary interventions (PCI), prepared PCI frequently falls victim to this site's vulnerabilities. Use of specialised devices could be advised in cases with high RAO rates to improve patient care. Thus, the purpose of this research was to study the frequency of RAO in DM patients 24 hours and one-month following TRA.

Materials and Methods

The study was carried out at Hayatabad Medical Complex, Peshawar from September 2021 to March 2022. In this research, participants over the age of 18 who received cardiac catheterization using the RA pathway were included. Patients who had undergone radial treatment previously, had a high risk of bleeding (glomerular filtration rates (GFR) of 2.6), were all had cardiovascular imbalance, had sclerosis, were on hemodialysis, or had local site infections were removed. Those who had poor radial access, meaning they could not effectively puncture the arteries, pass the wires, or put a sheathing, also were eliminated. It was aimed at reducing the complicating consequences of different cardiovascular and peripheral tissue damage amounts, heparin dosages, the manner and timing of hemostasis, sheath size, and the frequency of catheter swaps that may affect radial vs femoral accessibility.

All the patients underwent a RA palpation assessment and the traditional Barbeau diagnostic in the access hand. All patients received a bolus of 2.5mg verapamil and 200g nitroglycerin over the side-port of the sheath following successful sheath insertion. Every patient received a 5,000 IU unfractionated heparin bolus first dosage. During cutaneous CI, an additional bolus of heparin was administered to sustain an active clotting time range of 270-300s. Based on operator's preferences and the intricacy of the lesions, the guiding catheterization and sheath diameter were selected. The arterial membrane was detached following the treatment, and all patients received occlusion using a radial compression device (PreludeSYNC™) in accordance with the "patent hemostasis" procedure.

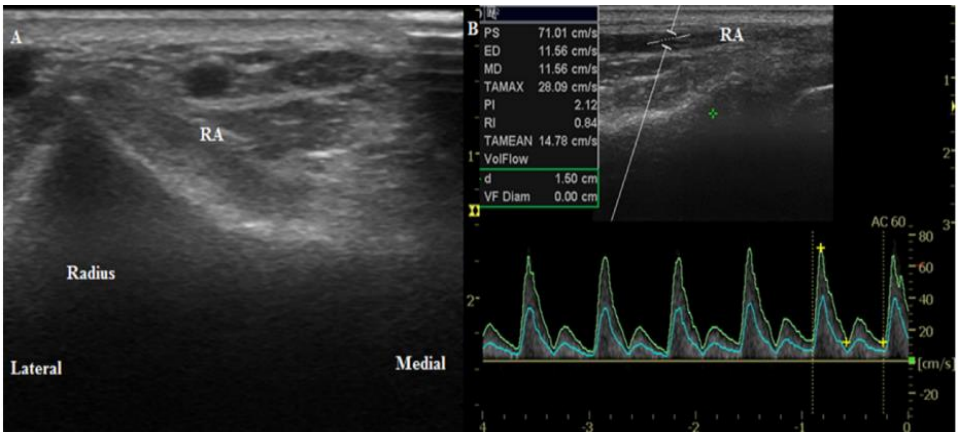

Figure 1. The RA as seen by ultrasound. (A) Tangential circular picture of the RA taken prior to induction of anaesthesia. Spectrum waveform for longitudinal duplex Doppler in (B)

When the PreludeSYNC™ was removed after the surgically implanted sheath was taken off, hemostasis had been accomplished and there was no sign of bleeding at the insertion site. After 24 hours, each patient underwent RA probing, the reverse Barbeau test (RBT), and a Doppler ultrasound examination to confirm the presence of RAO (Figure 1). On the thumb of the hand being examined during RBT, a pulse oximeter with a plethysmographic waveforms monitor was positioned. The ulnar artery was squeezed, and the plethysmographic wave's appearance was cautiously examined. In order to approve the analysis of RAO, a colour Doppler investigation was performed on all patients who had loss of waveform (type D) on RBT. Hemostasis had been achieved when the PreludeSYNCTM was withdrawn after the implanted tether was retrieved, as well as no evidence of bleeding at the insertion site. Each patient was subjected to RA probing, the RBT, and a Doppler ultrasonography examination after 24 hours to determine whether RAO was present. An RBT pulse oximeter with a plethysmographic waveforms monitor was positioned on the thumb of the hand being examined. Squeezing the ulnar artery and closely examining the plethysmographic wave's appearance were both performed. All patients who reported loss of waveform (type D) on RBT had a colour Doppler test to confirm the diagnosis of RAO.

SPSS was used to examine the data (v.25). When determining if a parameter was uniformly distributed or not, the Shapiro-Wilk analysis was used. The results were presented as means SD or median, accordingly. In order to determine if there were significantly different, the Mann-Whitney U test or unpaired t test was used. The percentage for the main result were shown. A suitable chi-square test or Fisher's exact test was used to do the univariate analysis, and risk ratios with 95% confidence intervals were given. Logistic regression was used to provide a multivariate analysis of variables. P-value≤0.05 was taken as statistically significance.

Results

1,303 individuals received 1,404 PCIs (including 101 repeat procedures after one month) from September 2021 to March 2022 throughout the research period. The patients were 1,018 (78.1%) men and 285 (21.6%) women, with a mean age of 57.6 years. Since 47 (3.2%) of them had uncertain primary outcomes, 1,303 patients' data could be included for the final analysis. Table 1 shows the pre-procedural and post-procedural characteristics of the study cohort. After TR catheterization, regression analysis was used to look at the determinants of RAO which discovered that RAO was predicted by female gender, cardiovascular variability, dyslipidemia, and a larger number of damaged arteries (table 2).

Table 1. Characteristics of the participants

Variables		Values Mean±SD
Age	Years	56.7 ± 14.1
Gender	Male, n (%)	1,018 (78.4)
	Female, n (%)	285 (21.6)
Initial creatinine		1.37 ± 0.15
Peak creatinine		1.55 ± 0.21
HbA1c	Glycated hemoglobin %	7.1
Fluoroscopy time	minutes	26.9 ± 34.2
Contrast volume		181 ± 90.6
Pre-PCI left ventricular ejection fraction		42.9 ± 11.2
Diabetes mellitus		546 (42.8)
Dyslipidaemia		449 (33.6)
Hypertension		773 (50.3)
Family history		275 (16.5)
Prior MI		198 (13.8)
Heart failure	n (%)	108 (7.1)
Diseased vessels	Double, n (%)	479 (35.7)
	Triple, n (%)	303 (24.2)
RAO	n (%)	149 (12.3)
Radial hematoma	n (%)	31 (2.8)

149 (12.3%) subjects in our research had documentation of research's primary result (table 2). The prevalence of RAO patient populations is shown in Table 2 along with the prevalence of women, hypertension, DM, family history, past myocardial infarction (MI), prior PCI (single and multivessel), and cardiovascular disorder. There were 46 women (30.2%) in the RAO group. In the RAO group, DM was found in 58 (39.5%) individuals. Table 2 shows that 34 (2.9%) RAO patients had cardiovascular disturbance. Significantly, among the RAO patients, 30 (20.1%) had a family history of MI. It is important to mention that 20 (13.9%) of the patients in our research had a history of previous MI. RAO was familiar more frequently in patient with cardiovascular variability throughout the process and in female 2.6% (p=0.002) and 30.2% (p=0.003), respectively (Table 2).

Table 2. Clinical characteristics and procedural data

Variables	RAO Patients with DM (n=149, 12.3%)	P-value
Female	46 (30.2%)	0.003
Hypertension	94 (63.7%)	0.566
Diabetes mellitus	58 (39.6%)	0.679
Family history	30 (20.1%)	0.648
Prior MI	20 (13.9%)	0.816
Prior PCI	19 (12.1%)	0.418
Multivessel PCI	63 (42.9%)	0.154
Cardiovascular disorder	31 (2.6%)	0.002
LVEF	67 (52.3%)	0.045

In non-DM individuals, RA diameter rose during anesthesia and remained elevated following RA catheter insertion. However, a higher radial diameter was once more observed in non-DM patients 24 h after catheterization, the diameter reduced shortly after catheter removal, resulting in equal sizes between two categories. In accordance with the sexual identity, "patients with dyslipidemia and cardiovascular disorder, the number of diseased vessels, two-vessel coronary artery disease (2VCAD) [compared to single-vessel coronary artery disease (SVCAD)], three-vessel coronary artery disease (3VCAD) [likened to SVCAD], and left ventricular (LV) dysfunction [ejection fraction (EF) 40% or less]" are all taken into consideration when calculating the frequencies of RAO, as shown in Table 3. No patients who had had CI experienced hematoma development, thrombosis, cannulation-related discomfort, or sensorial abnormalities after 24 hours, prior discharge from hospital, and after one month.

Table 3. Multiple regression analysis for predicting RA occlusion

Variables	OR	95% CI	P-value
Gender	1.849	1.521±2.469	0.003
Dyslipidaemia	0.761	0.540±0.292	0.012
Cardiovascular disorder	2.605	1.828±5.216	0.021
No. of diseased vessels	0.002	-	-
2VCAD	1.487	1.27±2.307	0.013
3VCAD	2.31	1.453±3.540	0.002
LV dysfunction (EF≤40%)	1.192	0.798±1.952	0.128

Aggregate indwelling sheathed time (hours) had an Area under the ROC Curve (AUC) of 0.843 (95% CI 0.778–0.909). The specificity, selectivity, and better diagnostic threshold of the RAO were 2.57 hours, 71.7%, and 75.9%, respectively, with $p<0.05$ (Figure 2).

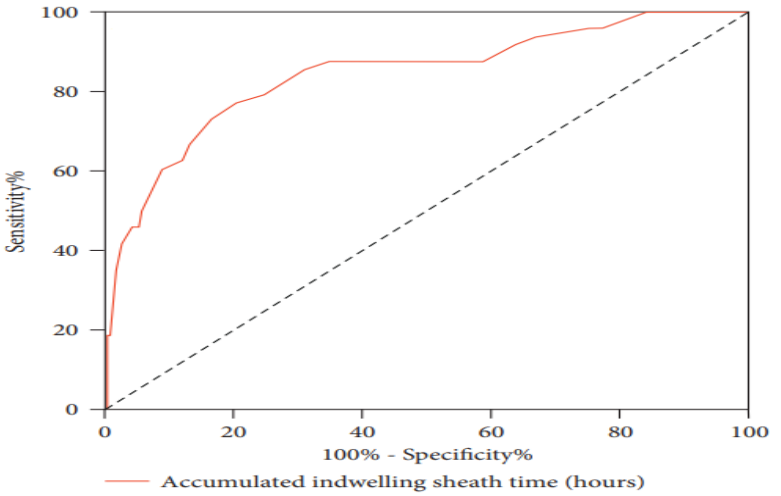

Figure 2. Diagnostic time limit of the RAO

Discussion

The article's significant observation was that 12.3% of patients who underwent TR cardiac catheterization methods had RAO identified at the hospital at departure or 24 hours after the operation, as shown by the RBT. The main factors that enhanced the likelihood of developing RAO were females, dyslipidemia, cardiovascular disorder, and a larger percentage of damaged coronary arteries. Several investigations have shown evidence of the RAO's spontaneously recanalization over time. The Munir et al. observed similar outcomes (2022). Rashid et al. (2016) reported that the occurrence of RAO ranged from 1-33% on the basis of period and mode of evaluation, and that it was 7.7% within 24 hours and dropped to 5.5% on follow-up.

Although the present research found a frequency of 12.3% in a total of 1,303 participants, a prospective non-randomized controlled Indian study comprised of 1,945 sequential patients having TRA indicated RAO in 17.5% at 24 hours' after process (Sinha et al., 2017). RAO was detected in 32.9% of 164 patients in a randomized research from Egypt after the surgery at 24 hours, and this percentage was shown to be decreased to 30% in six-month follow-up assessment using ultrasonography Doppler (Sadaka et al., 2019). HemoBand versus TR band was compared in a study by Pancholy (2009) for hemostasis following TR catheterization, and the TR band group had an occlusion rate of 4.5% whereas HemoBand category had an occlusion rate of 11.2%, It contrasts with the results of our study, where we recorded a RAO rate of 12.3%. RAO was noted in 11.7% of the 1,706 participants in Dharma et al. (2015), which is virtually identical to the results of our research.

RAO risk variables included female gender, cardiac instability, multivessel disorder, and dyslipidemia, according to a multivariate study. Sadaka et al. (2019) discovered that female gender is an indicator of risk for RAO (p0.001), which is consistent with our study's findings that 21.6% of females and 78.4% of male participants produced RAO (p=0.003). In comparison to their observations,

however, age was not an element in determining RAO in current research. Sinha et al. (2017) noted that female gender was also a risk factor for developing diabetes mellitus, however our analysis refutes this conclusion, showing that 39.6% of DM patients also had RAO (p=0.791). Although other research have shown this result, age was not a factor in our investigation when it came to RAO (Rashid *et al.*, 2016).

RAO is detected in one of two ways: either by an ultrasonic Doppler inspection or a bedside test that includes pulse sensor and plethysmography. It is also noteworthy to note when RAO is discovered. A palpable pulse was detected in 34% of patients who were diagnosed with RAO by US Doppler examination, according to findings reported by Sinha et al. (2017), highlighting a significant difference in the data at hand. Nevertheless, because our analysis was retrospective in nature, we were unable to use the US doppler data pre- as well as post-procedure, that would have allowed us to enhanced comprehension and categorise the interpreters of RAO. The preliminary step Studying the architecture of the RA using US Doppler data is crucial for guaranteeing the efficacy of the surgery, preventing problems, and enhancing patient comfort (Chugh et al., 2013).

Our research has several restrictions. This research included participants who were planned for renal transplantation in effort to reduce needless arterial catheterization and only include those who truly require arterial cannulation for invasive blood pressure monitoring during surgery. Due to the arteriopathy associated with primary renal illness, this particular group of individuals may undoubtedly have an impact on the arteries' vasoreactivity. Secondly, since these factors hasten DM-related microvascular and macrovascular consequences, intergroup variations in underlying hypertension and DM prevalence may have had an impact on endothelium features. Although there were no discernible variations in atherosclerotic prevalence between DM and non-DM patients, it should still be possible that non-DM individuals had additional systemic disorders linked to atherosclerosis. These patient features may have an impact on endothelial dysfunction in addition to diabetes. Finally, while we made the most of the ultrasound's usefulness by obtaining several measurements using a skilled sonographer for each scan, we could only slightly improve the accuracy of the results. Although there are other high-accuracy techniques including plethysmography, arteriography, and flow-mediated enlargement, they do not offer the same convenience and convenience as sonography.

Conclusion

RAO is frequently an asymptomatic CI issue and was widespread, particularly in the Pakistani community. In order to adapt to abrupt changes in radial arterial flow during RAO during general anaesthetic, patients with DM lack the vasoreactivity of the RA. For high-risk patients, a thoughtful treatment strategy and follow-up must be developed in order to guarantee RA patency and predictor information might be useful in preventing it.

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